200.09D – Pluto's atmosphere from stellar

occultations in 2012 and 2013

We present results from two Pluto stellar occultations observed on

18 July 2012 and 04 May 2013, and monitored respectively from

five and six sites in South America. Both campaigns involved large

telescopes (including the 8.2-m VLT at ESO/Paranal). The high

SNR ratios and multi-chord coverage provide amoung the best

Pluto atmospheric profiles ever obtained from the ground.

We show that a spherically symmetric, clear (no-haze) and pure N2

atmosphere with a unique temperature profile satisfactorily fits the

twelve lightcurves provided by the two events. We find, however, a

small but significant increase of pressure of 6% (6-sigma level)

between the two dates, with values of 2.16 ± 0.2 and 2.30 ± 0.01

μbar at the reference radius 1275 km, respectively.

We provide atmospheric constrains between 1190 km and 1450 km

from Pluto's center, and we determine the temperature profile with

accuracy of a few km in vertical scale. Our model shows a

stratosphere with strong positive gradient between 1190 km (at 36

K, 11 μbar) and r =1215 km (6.0 μbar), where a temperature

maximum of 110 K is reached. Above it is a mesosphere with

negative thermal gradient of -0.2 K/km up to 1,390 km (0.25 μbar),

at which point, the mesosphere connects itself to a more

isothermal upper branch at 81 K. This profile provides (assuming

no troposphere) a Pluto surface radius of 1190 ± 5 km, consistent

with preliminary values obtained by New Horizons. Currently

measured CO abundances are too low to explain the negative

mesospheric thermal gradient. We explore the possibility of an

HCN (recently detected by ALMA) cooling. This model, however,

requires largely supersaturated HCN. Zonal winds and vertical

compositional variations of the atmosphere are also unable to

explain the observed mesospheric trend.

These events are the last useful ground-based occultations

recorded before the 29 June 2015 occultation observed from

Australia and New Zealand, and before the NASA's New Horizons

flyby of July 2015. This work can serve as a benchmark in the New

Horizons context, enabling comparisons between ground-based

and space results concerning Pluto's atmospheric structure and

temporal evolution.

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